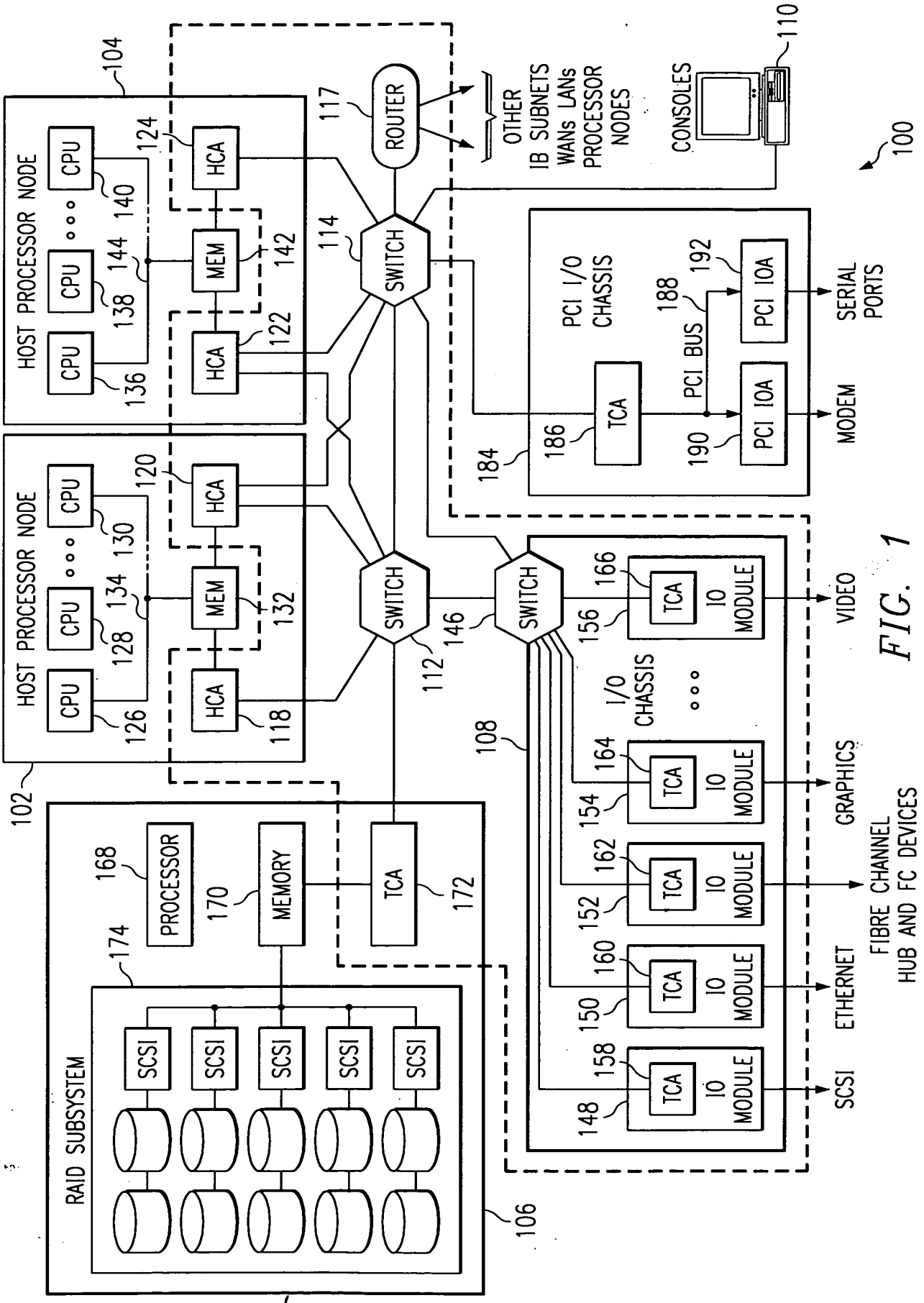

100
102
104
106
108
110
112
114
117
118
120
122
124
126
128
130
132
134
136
138
140
142
144
146
148
150
152
154
156
158
160
162
164
166
168
170
172
174
184
186
188
190
192
HOST PROCESSOR NODE
CPU
HCA
MEM
ROUTER
OTHER IB SUBNETS WANs LANs PROCESSOR NODES
CONSOLES
SWITCH
PCI I/O CHASSIS
PCI BUS
PCI IOA
TCA
SERIAL PORTS
MODEM
I/O CHASSIS
IO MODULE
VIDEO
GRAPHICS
ETHERNET
SCSI
FIBRE CHANNEL HUB AND FC DEVICES
PROCESSOR
MEMORY
RAID SUBSYSTEM
SCSI

FIG. 1

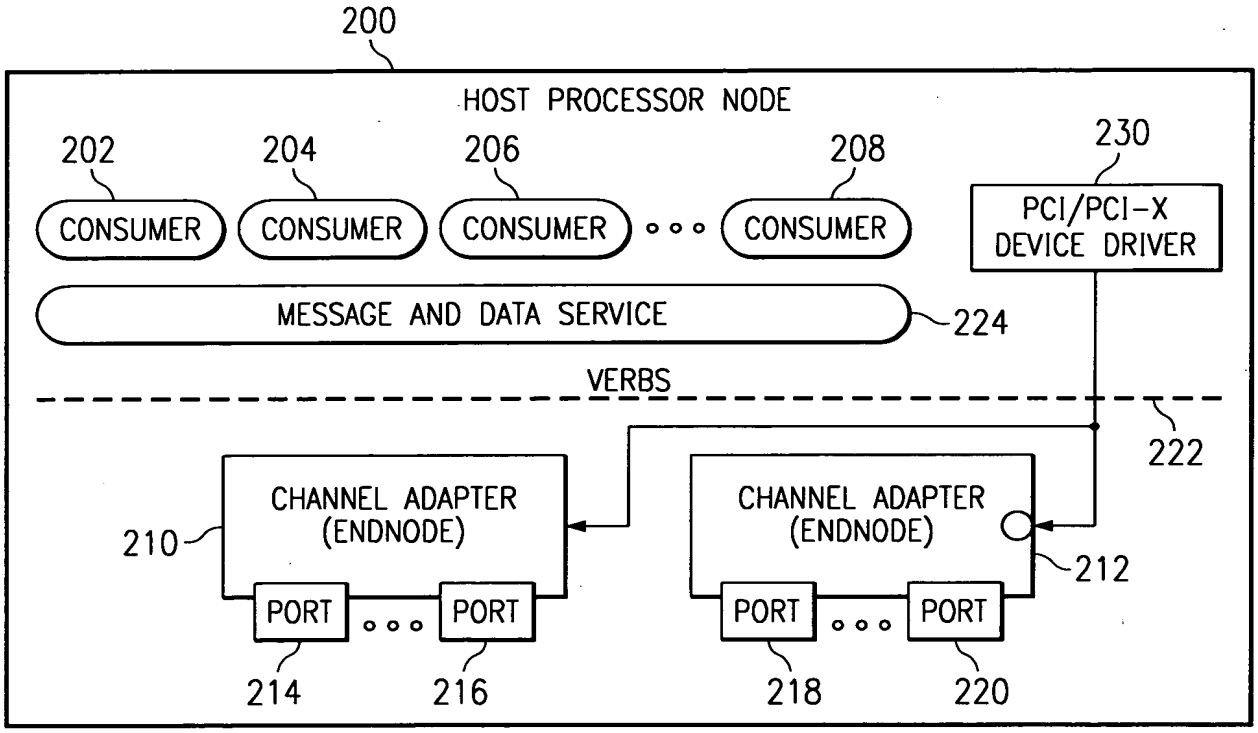

200
HOST PROCESSOR NODE
202
204
206
208
CONSUMER
CONSUMER
CONSUMER
CONSUMER
230
PCI/PCI-X
DEVICE DRIVER
MESSAGE AND DATA SERVICE
224
VERBS
222
CHANNEL ADAPTER
(ENDNODE)
210
PORT
PORT
214
216
CHANNEL ADAPTER
(ENDNODE)
212
PORT
PORT
218
220

FIG. 2

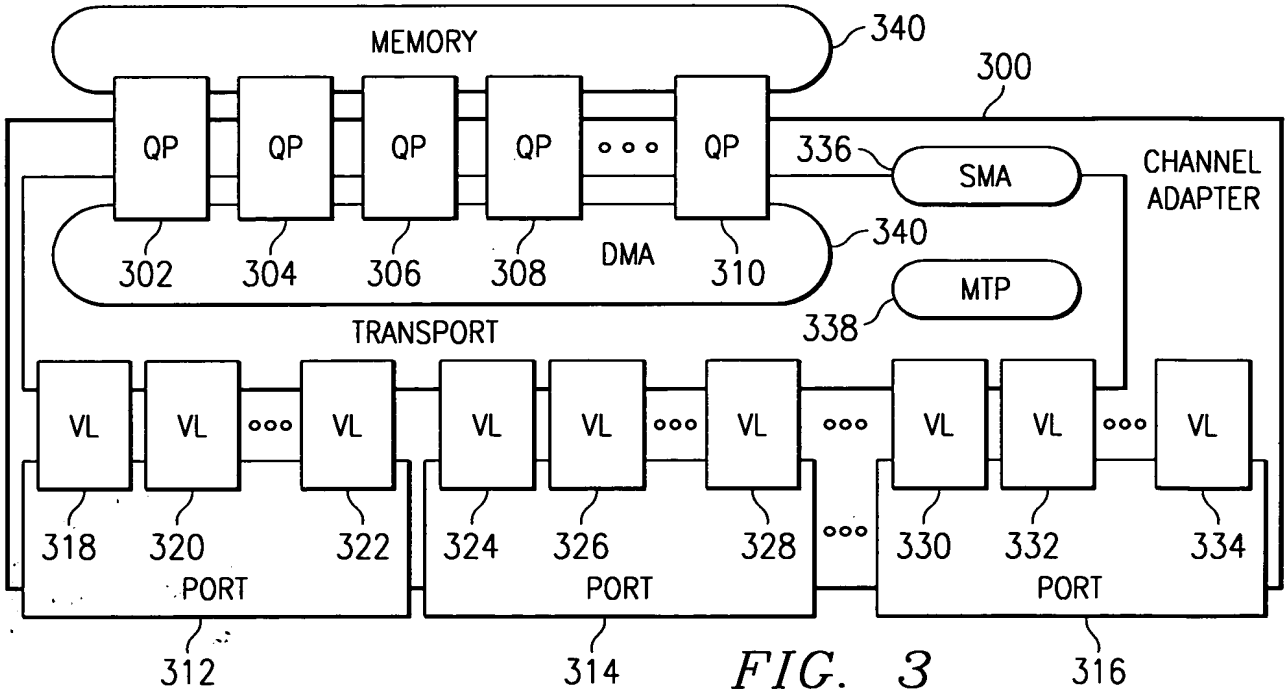

MEMORY
340
300
QP
QP
QP
QP
QP
336
SMA
CHANNEL
ADAPTER
302
304
306
308
DMA
310
340
MTP
338
TRANSPORT
VL
VL
VL
VL
VL
VL
VL
VL
VL
318
320
322
324
326
328
330
332
334
PORT
PORT
PORT
312
314
316

FIG. 3

FIG. 4

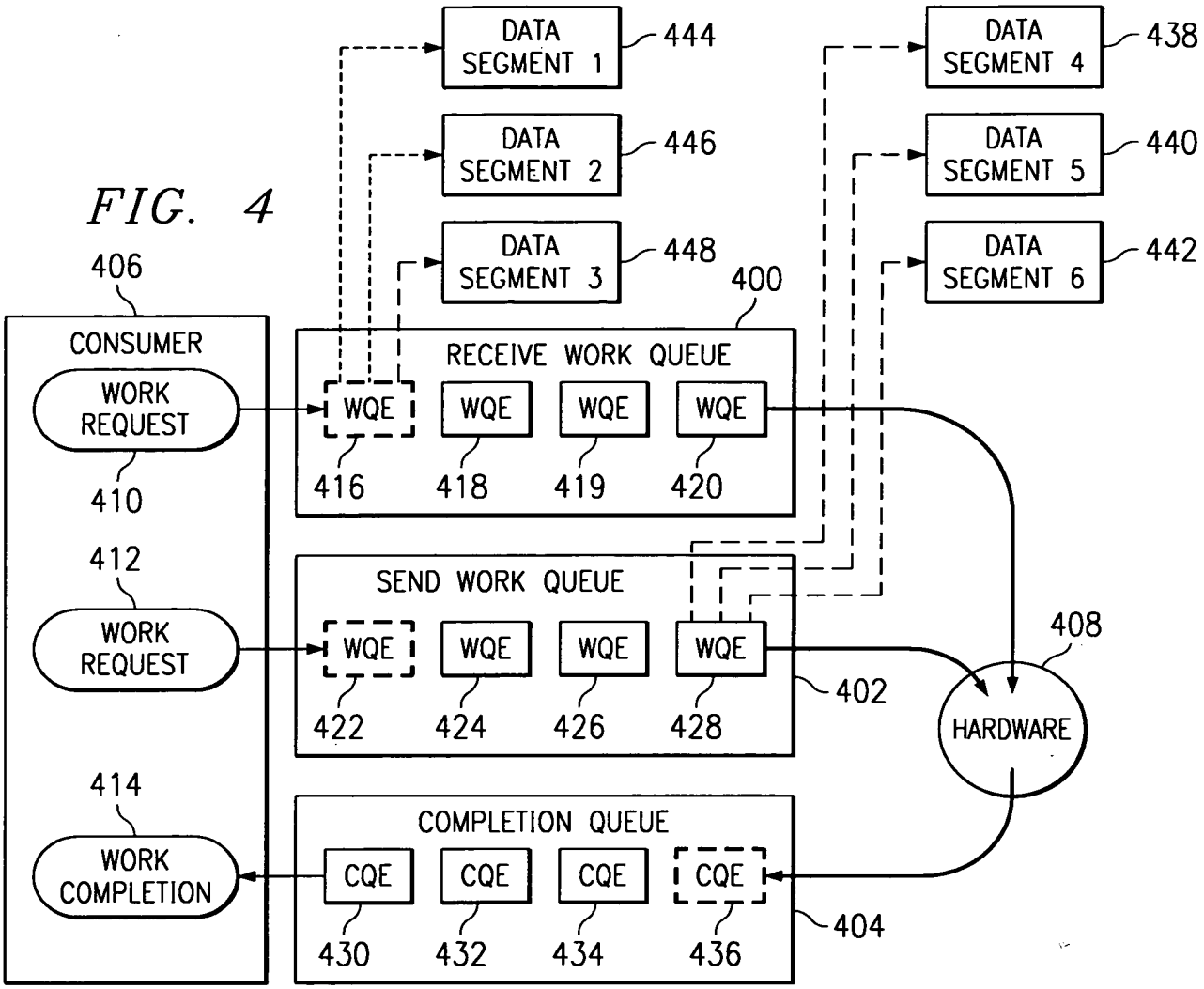

DATA SEGMENT 1
444
DATA SEGMENT 2
446
DATA SEGMENT 3
448
DATA SEGMENT 4
438
DATA SEGMENT 5
440
DATA SEGMENT 6
442
406
CONSUMER
WORK REQUEST
410
412
WORK REQUEST
414
WORK COMPLETION
400
RECEIVE WORK QUEUE
WQE
WQE
WQE
WQE
416
418
419
420
SEND WORK QUEUE
WQE
WQE
WQE
WQE
422
424
426
428
402
408
HARDWARE
COMPLETION QUEUE
CQE
CQE
CQE
CQE
430
432
434
436
404

FIG. 5

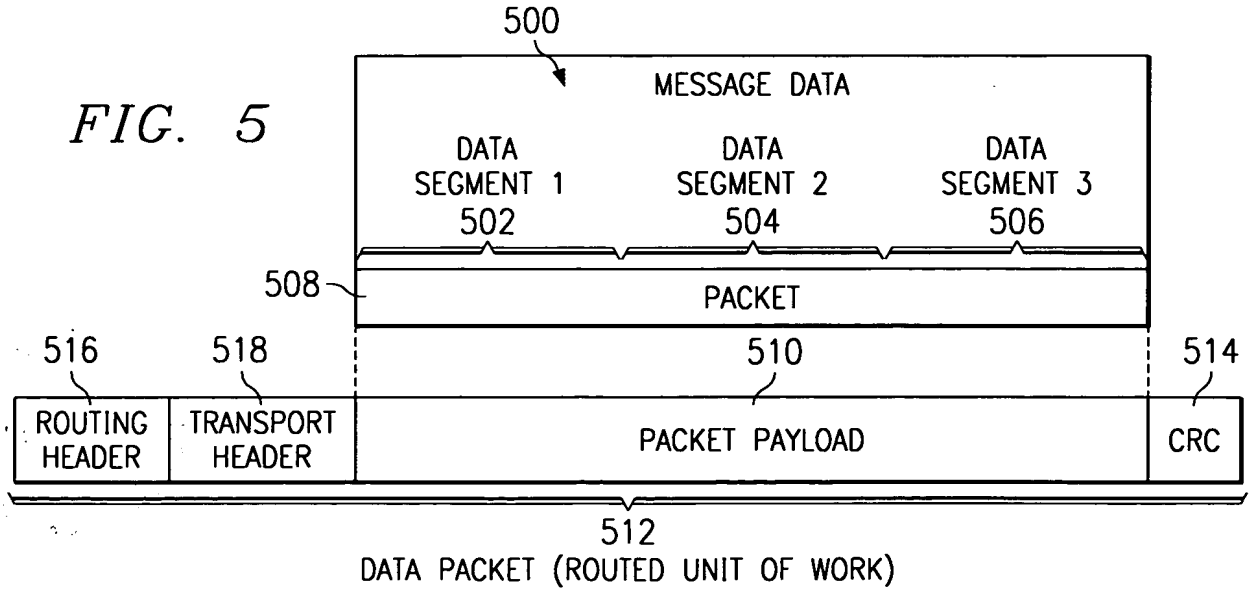
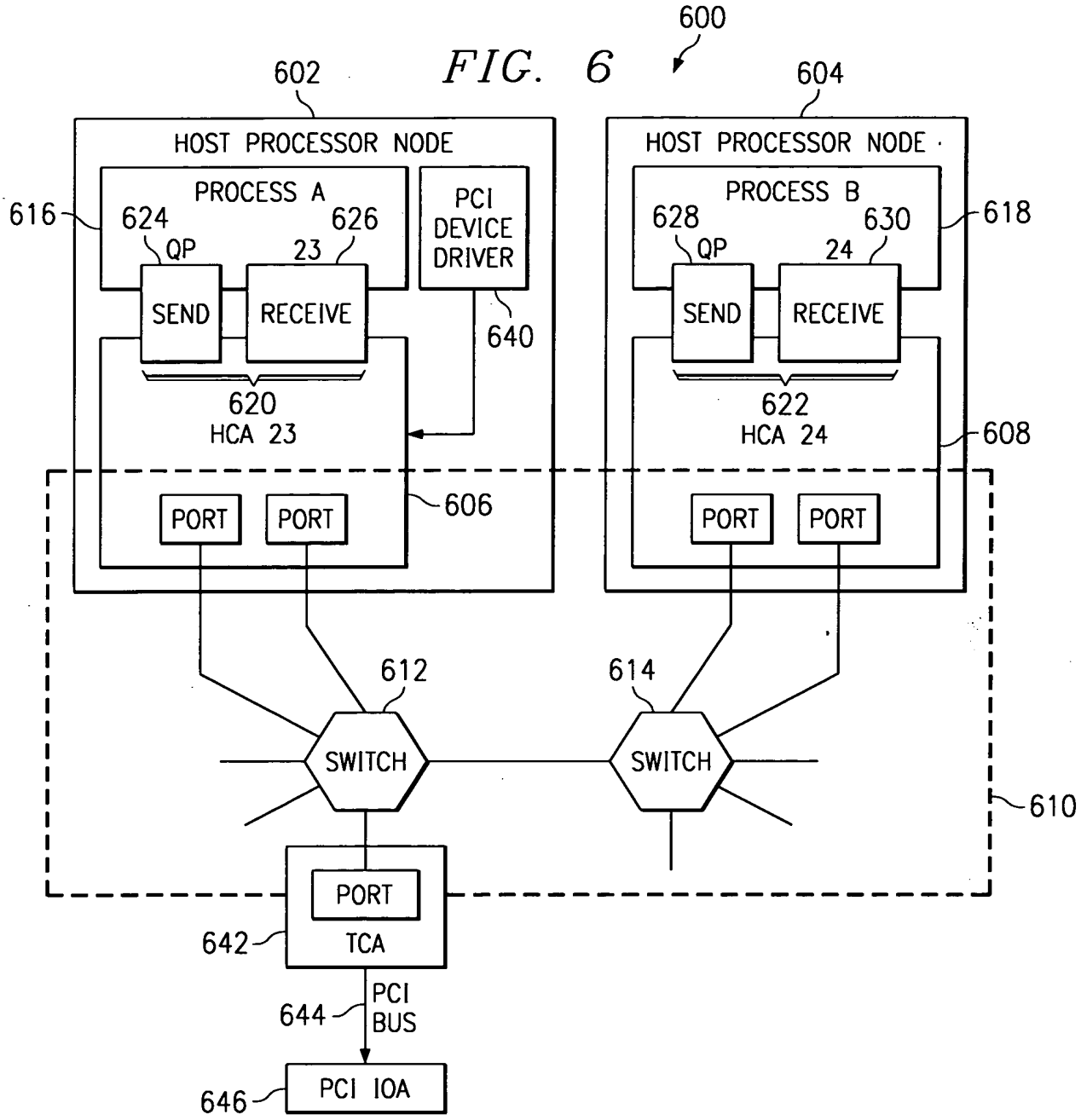

500
MESSAGE DATA
DATA SEGMENT 1
502
DATA SEGMENT 2
504
DATA SEGMENT 3
506
508
PACKET
516
518
510
514
ROUTING HEADER
TRANSPORT HEADER
PACKET PAYLOAD
CRC
512
DATA PACKET (ROUTED UNIT OF WORK)

FIG. 6


600
602
604
HOST PROCESSOR NODE
HOST PROCESSOR NODE
PROCESS A
PROCESS B
PCI DEVICE DRIVER
616
624
626
628
630
618
QP
23
24
SEND
RECEIVE
640
620
HCA 23
622
HCA 24
608
606
PORT
612
614
SWITCH
610
642
TCA
644
PCI BUS
646
PCI IOA

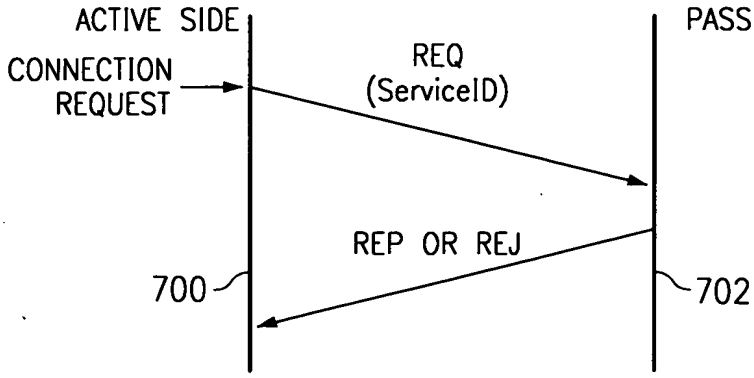

ACTIVE SIDE
PASSIVE SIDE
CONNECTION REQUEST
REQ (ServiceID)
REP OR REJ
700
702

FIG. 7

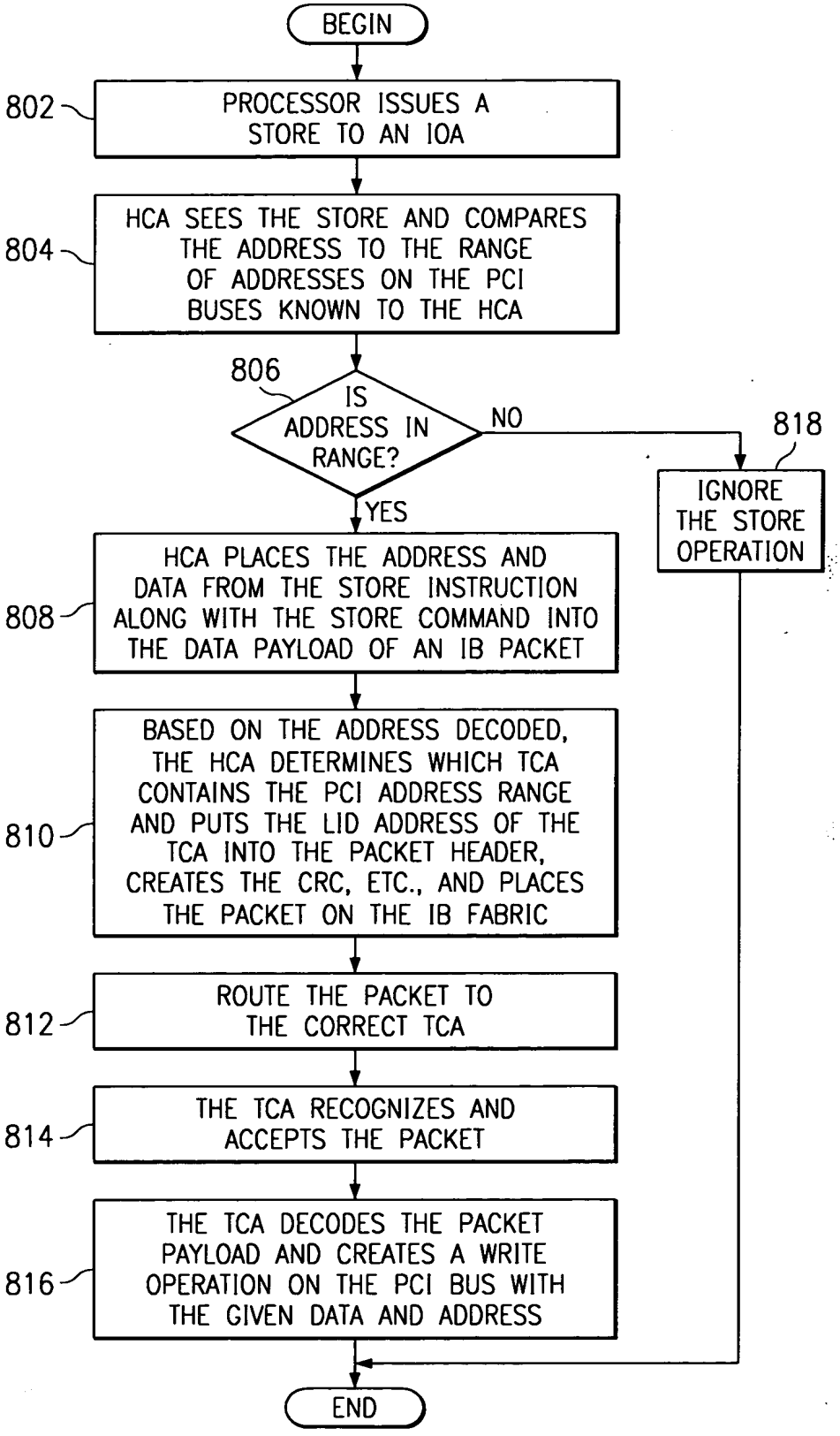

BEGIN
802
PROCESSOR ISSUES A STORE TO AN IOA
804
HCA SEES THE STORE AND COMPARES THE ADDRESS TO THE RANGE OF ADDRESSES ON THE PCI BUSES KNOWN TO THE HCA
806
IS ADDRESS IN RANGE?
NO
818
IGNORE THE STORE OPERATION
YES
808
HCA PLACES THE ADDRESS AND DATA FROM THE STORE INSTRUCTION ALONG WITH THE STORE COMMAND INTO THE DATA PAYLOAD OF AN IB PACKET
810
BASED ON THE ADDRESS DECODED, THE HCA DETERMINES WHICH TCA CONTAINS THE PCI ADDRESS RANGE AND PUTS THE LID ADDRESS OF THE TCA INTO THE PACKET HEADER, CREATES THE CRC, ETC., AND PLACES THE PACKET ON THE IB FABRIC
812
ROUTE THE PACKET TO THE CORRECT TCA
814
THE TCA RECOGNIZES AND ACCEPTS THE PACKET
816
THE TCA DECODES THE PACKET PAYLOAD AND CREATES A WRITE OPERATION ON THE PCI BUS WITH THE GIVEN DATA AND ADDRESS
END

FIG. 8

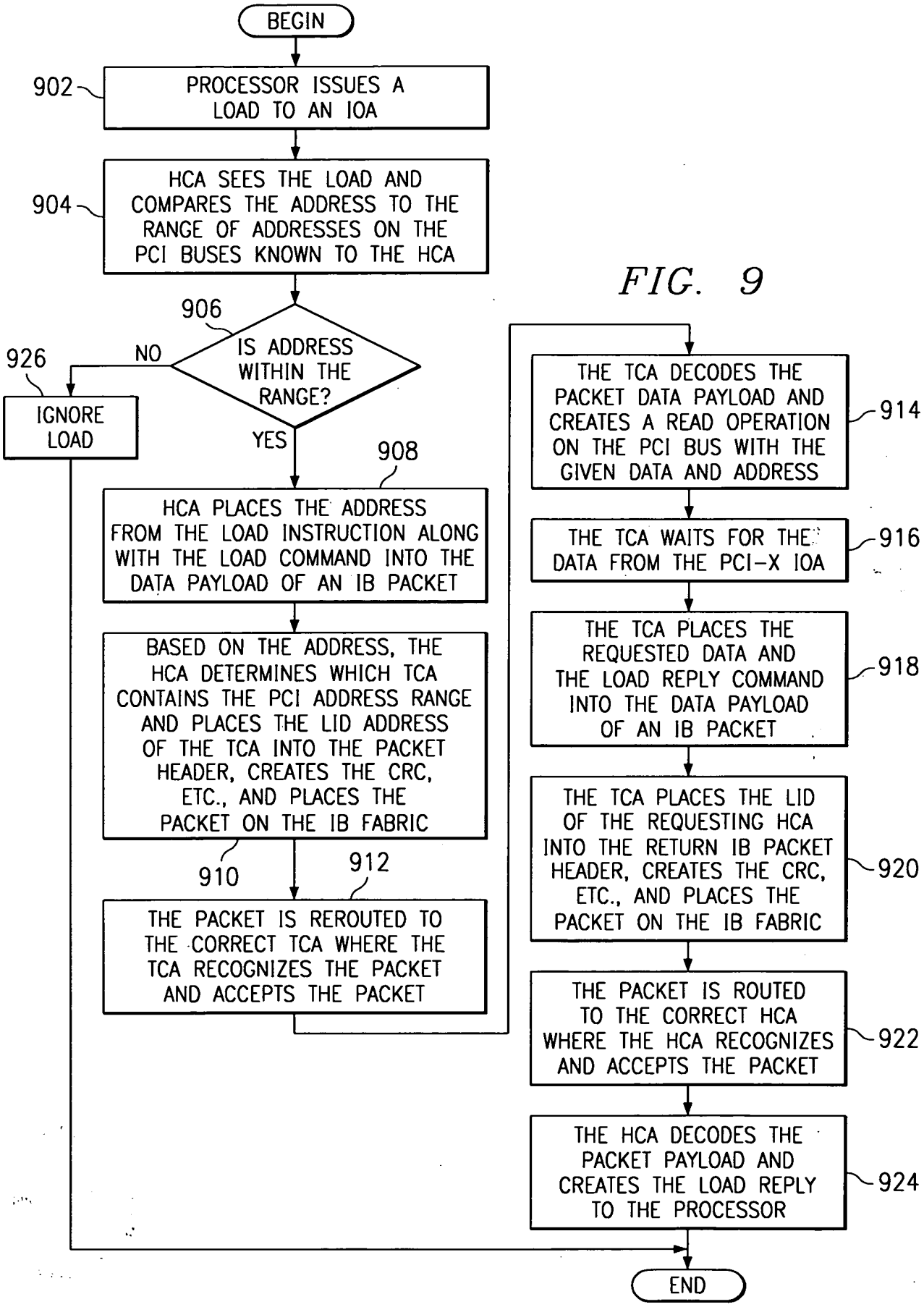

BEGIN
902
PROCESSOR ISSUES A LOAD TO AN IOA
904
HCA SEES THE LOAD AND COMPARES THE ADDRESS TO THE RANGE OF ADDRESSES ON THE PCI BUSES KNOWN TO THE HCA
906
IS ADDRESS WITHIN THE RANGE?
NO
926
IGNORE LOAD
YES
908
HCA PLACES THE ADDRESS FROM THE LOAD INSTRUCTION ALONG WITH THE LOAD COMMAND INTO THE DATA PAYLOAD OF AN IB PACKET
BASED ON THE ADDRESS, THE HCA DETERMINES WHICH TCA CONTAINS THE PCI ADDRESS RANGE AND PLACES THE LID ADDRESS OF THE TCA INTO THE PACKET HEADER, CREATES THE CRC, ETC., AND PLACES THE PACKET ON THE IB FABRIC
910
912
THE PACKET IS REROUTED TO THE CORRECT TCA WHERE THE TCA RECOGNIZES THE PACKET AND ACCEPTS THE PACKET
THE TCA DECODES THE PACKET DATA PAYLOAD AND CREATES A READ OPERATION ON THE PCI BUS WITH THE GIVEN DATA AND ADDRESS
914
THE TCA WAITS FOR THE DATA FROM THE PCI-X IOA
916
THE TCA PLACES THE REQUESTED DATA AND THE LOAD REPLY COMMAND INTO THE DATA PAYLOAD OF AN IB PACKET
918
THE TCA PLACES THE LID OF THE REQUESTING HCA INTO THE RETURN IB PACKET HEADER, CREATES THE CRC, ETC., AND PLACES THE PACKET ON THE IB FABRIC
920
THE PACKET IS ROUTED TO THE CORRECT HCA WHERE THE HCA RECOGNIZES AND ACCEPTS THE PACKET
922
THE HCA DECODES THE PACKET PAYLOAD AND CREATES THE LOAD REPLY TO THE PROCESSOR
924
END

FIG. 9

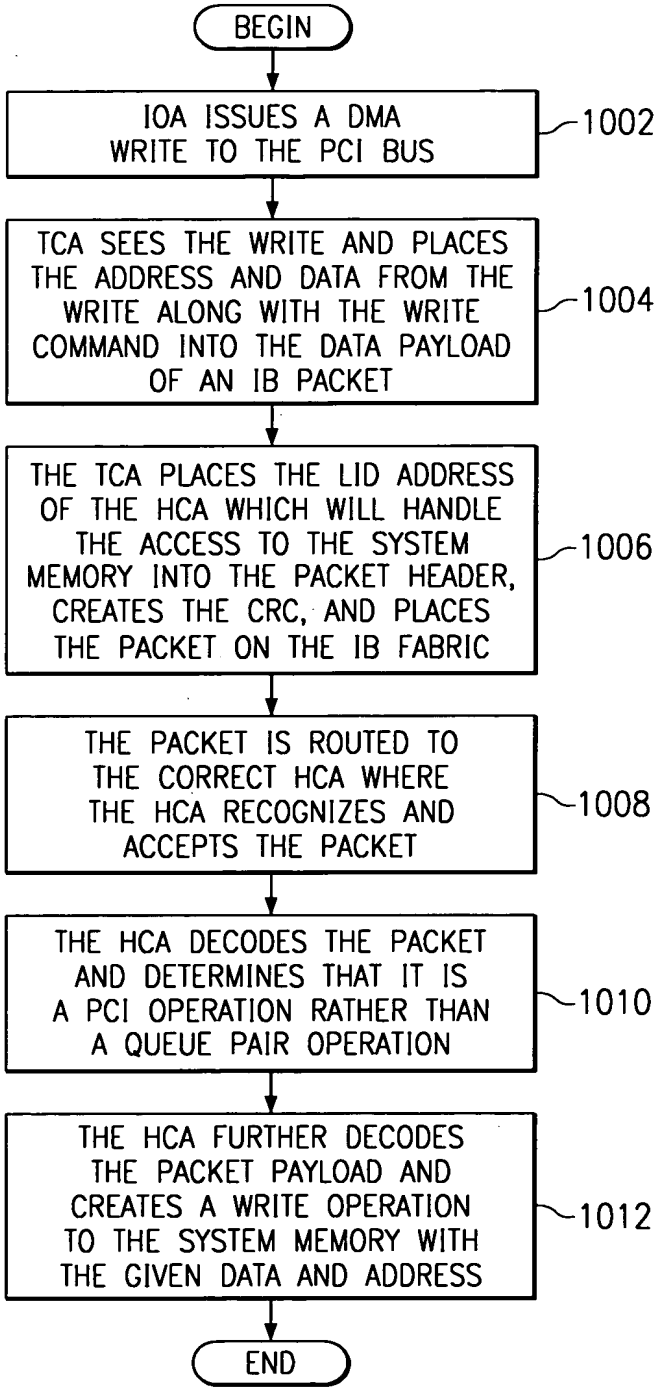

BEGIN
IOA ISSUES A DMA WRITE TO THE PCI BUS
1002
TCA SEES THE WRITE AND PLACES THE ADDRESS AND DATA FROM THE WRITE ALONG WITH THE WRITE COMMAND INTO THE DATA PAYLOAD OF AN IB PACKET
1004
THE TCA PLACES THE LID ADDRESS OF THE HCA WHICH WILL HANDLE THE ACCESS TO THE SYSTEM MEMORY INTO THE PACKET HEADER, CREATES THE CRC, AND PLACES THE PACKET ON THE IB FABRIC
1006
THE PACKET IS ROUTED TO THE CORRECT HCA WHERE THE HCA RECOGNIZES AND ACCEPTS THE PACKET
1008
THE HCA DECODES THE PACKET AND DETERMINES THAT IT IS A PCI OPERATION RATHER THAN A QUEUE PAIR OPERATION
1010
THE HCA FURTHER DECODES THE PACKET PAYLOAD AND CREATES A WRITE OPERATION TO THE SYSTEM MEMORY WITH THE GIVEN DATA AND ADDRESS
1012
END

FIG. 10

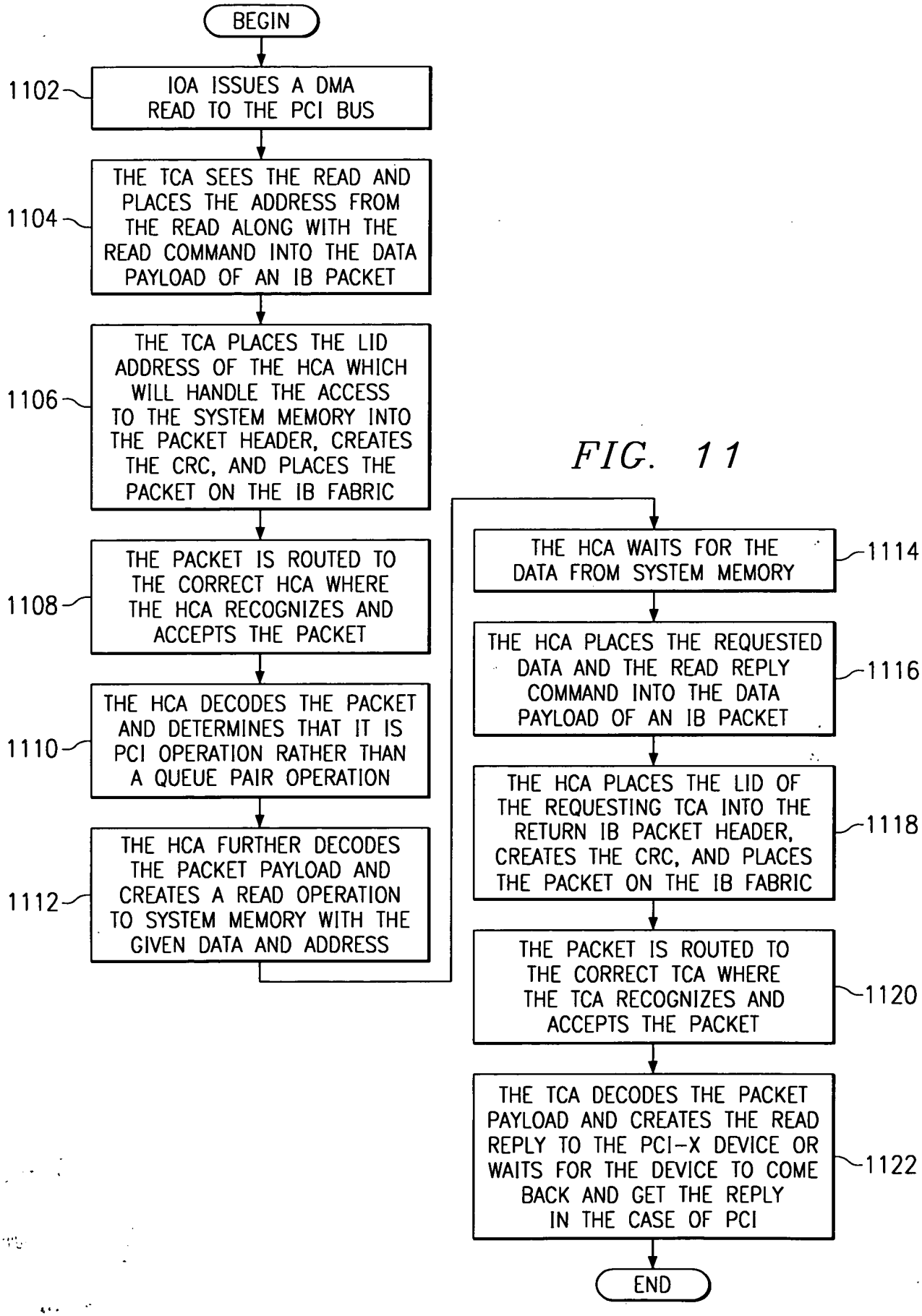

BEGIN
1102
IOA ISSUES A DMA READ TO THE PCI BUS
1104
THE TCA SEES THE READ AND PLACES THE ADDRESS FROM THE READ ALONG WITH THE READ COMMAND INTO THE DATA PAYLOAD OF AN IB PACKET
1106
THE TCA PLACES THE LID ADDRESS OF THE HCA WHICH WILL HANDLE THE ACCESS TO THE SYSTEM MEMORY INTO THE PACKET HEADER, CREATES THE CRC, AND PLACES THE PACKET ON THE IB FABRIC
1108
THE PACKET IS ROUTED TO THE CORRECT HCA WHERE THE HCA RECOGNIZES AND ACCEPTS THE PACKET
1110
THE HCA DECODES THE PACKET AND DETERMINES THAT IT IS PCI OPERATION RATHER THAN A QUEUE PAIR OPERATION
1112
THE HCA FURTHER DECODES THE PACKET PAYLOAD AND CREATES A READ OPERATION TO SYSTEM MEMORY WITH THE GIVEN DATA AND ADDRESS
1114
THE HCA WAITS FOR THE DATA FROM SYSTEM MEMORY
1116
THE HCA PLACES THE REQUESTED DATA AND THE READ REPLY COMMAND INTO THE DATA PAYLOAD OF AN IB PACKET
1118
THE HCA PLACES THE LID OF THE REQUESTING TCA INTO THE RETURN IB PACKET HEADER, CREATES THE CRC, AND PLACES THE PACKET ON THE IB FABRIC
1120
THE PACKET IS ROUTED TO THE CORRECT TCA WHERE THE TCA RECOGNIZES AND ACCEPTS THE PACKET
1122
THE TCA DECODES THE PACKET PAYLOAD AND CREATES THE READ REPLY TO THE PCI-X DEVICE OR WAITS FOR THE DEVICE TO COME BACK AND GET THE REPLY IN THE CASE OF PCI
END

FIG. 11